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TELEVISION FRINGE BENEFITS

Today nearly everyone watches television; some just watch it better than others. "Better" refers to viewers in areas where a number of channels are received with equal clarity. Now there is hope for the others, the people who live in fringe areas that have difficulty getting any channel with ease. One of the many research projects in the University of Illinois Antenna Research Laboratory has been the development of VHF television antennas capable of receiving all VHF channels equally well. Professor Paul E. Mayes and Robert L. Carrel of the Department of Electrical Engineering have jointly invented an antenna which helps to solve that problem. Called a "resonant-V" antenna, the device is superior to other antennas used for long distance TV reception. Most of the old type VHF antennas receive one channel better than others; with the Mayes-Carrel invention all VHF stations can be picked up equally well.

One model of the new antenna has fourteen aluminum rods that are swept forward in a V-shape design. These rods are attached diagonally to two central eight-foot rods which are in turn attached to a supporting pole at right angles to the out-stretched "V" array. The antenna can be mounted on a tower or atop a house and turned in the direction of the television stations it is trying to pick up. The new antenna promises to be useful for viewers in fringe areas that are served by two or more stations in different cities.

In addition to the "resonant-V" antenna for VHF reception, Mayes and Carrel have also designed a UHF and a combination VHF-UHF antenna for balanced reception of stations broadcasting over both kinds of channels.

Patent applications have been made by the University of Illinois Foundation and negotiations are under way to have the antenna manufactured. If you are one of the people who live in an area where reception is poor, you can at least look forward to better viewing in the future when the resonant-V antenna is made available.

STUDIES IN SPACIAL AEROTRIANGULATION

The University of Illinois has become one of eight photogrammetric centers over the world to participate in an international research program on spacial aerotriangulation. Dr. H. M. Karara, Associate Professor of Civil Engineering, is directing the U. of I.'s part in the program.

Aerotriangulation is a photogrammetric technique for providing control over extended areas by measurements on aerial photographs. It has recently assumed new importance because of its usefulness in reducing the amount of ground control required in the production of maps of large areas.

"Ground control" is the use of points established by survey on the ground. This is a time-consuming and expensive process, and in military operations sometimes impossible. By use of aerotriangulation, the number of such ground control points is sharply reduced.

The National Science Foundation has awarded the University of Illinois Department of Civil Engineering a grant of \$56,900 for a two-year basic study in this field. Most of the experimental phases of the NSF-supported work will be part of the international research project administered by the International Society of Photogrammetry. The Ohio State University and the University of Illinois are the only two U.S. participants in the program. The others are the Swiss Federal Institute of Technology in Zurich, the Technische Hochschule in Frankfurt, the Polytechnical Institute in Milan, the International Training Center for Aerial Surveys in Delft, the Canadian National Research Council in Ottawa, and the National Geographic Institute in Paris.

A major part of the study will be focused on the "cross-bases" method, a relatively new technique of aerotriangulation developed by Professor Karara in 1955 at the Swiss Federal Institute of Technology in Zurich. During the last four years, this method has been the subject of research under the sponsorship of the University of Illinois Research Board.



Ward R. Malish (right) of Henry, Illinois, winner of the 7th C. C. Wiley Award at University of Illinois, tells Professor Wiley about the 6,500-mile trip through 13 states and the District of Columbia to gather data and pictures on current highway work. The award honors Professor Wiley, pioneer in traffic engineering, who retired in 1952 after 46 years on the University staff. Information and photos brought back by Malish will be used by the University's Civil Engineering Department.

THE REAL MEN BEHIND THE MISSILES

This is the first time an article from another publication has been reprinted in *Outlook*, but this statement by E. C. Easton, Dean of Engineering at Rutgers University, published in the latest issue of *Engineer*, deserves wider circulation among non-engineers. Mr. Easton says something which has needed to be said for a long time . . .

BUT FOR THE ENGINEERS ASTRONAUTS ARE NAUGHT

Recently the names of Gagarin, Shepard, Grissom, and Titov were featured prominently in the American press. All four had been passengers in vehicles designed, built, and operated by others. Despite their relatively passive roles in their respective adventures these men were hailed and feted as though each had performed the miracle of space flight single-handedly. There was an editorial in The New York Times after Shepard's flight in which Shepard and even the astronauts who were trained, but did not make the flight, were given credit. Such reporting reveals an alarming ignorance of the area of responsibility for technological advances.

Let us have at least a faint cheer for the engineers who designed, built, launched, and controlled the vehicle in which these space passengers rode. Let's be sure that the public knows that the real heroes were engineers, not scientists or astronauts. The scientific principles which govern space flight are few and simple. The engineering applications of those principles to accomplish a successful flight are incredibly complex.

An engineer told Shepard exactly what to expect at every instant of that flight. He told Shepard that he would experience so many G's within 15 seconds; that, at such a time, the periscope would come down; that, at a given time, the rotating rocket would fire and that, at another specified time, the retrograde rocket would fire.

The exciting thing is that someone on the ground, an engineer, was able to predict this before the rocket was fired. Furthermore, Shepard had in front of him a little globe on which the position of that capsule was located at every instant, and on which there was an arrow pointing to a landing place, if Shepard were to push the retrograde rocket button. How is it possible to design a thing that will tell a man in a tumbling space vehicle exactly where he is at any instant of time? This ability to design a complex vehicle and to predict its performance before it leaves the ground is the most exciting feature of space flight. It is the most sophisticated talent ever possessed by the human race and it is the mark of the engineer.

PARTNERS IN RESEARCH

Research cooperation between universities and industry can pay big dividends for both, each in its own coin. Industry can gain new products and techniques, and universities can strengthen research and teaching programs without lowering academic standards. This was the picture presented by Dean W. L. Everitt of the University of Illinois College of Engineering, speaking at the National Electronics Conference in Chicago on October 11.

A prominent researcher and educator in electronics, Dean Everitt spoke specifically of the electronics industry in the Midwest, but he offered his views as applying generally to university-industry cooperation. For the Midwest, he pointed up the need for more such joint effort. The University of Illinois, he said, is doing research in electronics and related areas at a rate of more than \$5,000,000 a year. Industry in the region, however, is not matching that level of research activity. He urged industry to increase its research activity and interest, and he outlined ways in which industry could work effectively with universities of the region on common problems.

"To cooperate effectively with a university," he said, "a private company must understand the nature of the academic community." Referring to the university as "a community of scholars," Dean Everitt said: "Most of the companies in the electronic field which are expanding significantly are also places of learning. To interact properly with universities, industry can, and must, itself be-

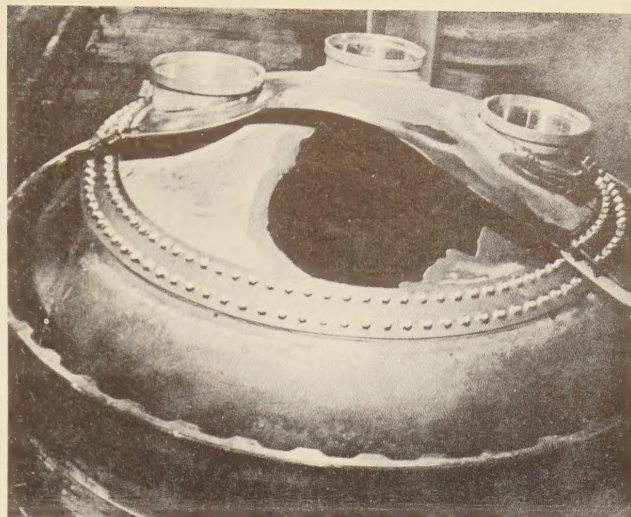
come a part of the community of scholars." One way to accomplish this, he said, would be for industry to locate advanced research and development facilities in close physical proximity to the universities. This would provide the industry research staffs with intellectual development and stimulation that cannot be done away from a campus, allow them to attend the seminars which take place on the campus, and provide better opportunities for university members to serve as consultants to industry and industry staffs to serve as consultants to the university.

Finally, Dean Everitt recommended that industry adopt the university's custom of allowing its staff members to take sabbatical leaves to visit and work with other institutions. "Should not industry," he asked, "provide leaves, with pay, for their research engineers to participate in the more basic and advanced research which is characteristic of the university, or in some cases even at other industrial research laboratories?" He also suggested that industry should cooperate with the universities in providing their employees with the opportunity for advanced education in residence on the university campus. Dean Everitt closed with the statement that such a harmonious relationship between the universities and industry would be possible and mutually beneficial if both sides looked upon themselves as partners striving for a common goal.

TREMENDOUS TRIFLES — IT'S THE LITTLE THINGS THAT COUNT

Failures of missiles, buildings, ships, and bridges are often dramatic, sometimes catastrophic, and always educational. The explosion of a missile at launch is particularly dramatic and, at best, carries a suggestion of catastrophe by pinpointing a weakness in our defense system. When the remains are pieced together, the investigators may decide that a microscopic flaw, greatly expanded by the pressures of firing, was the cause of failure. The education comes from learning why the flaw existed and how it caused the failure. The prediction and prevention of such brittle fractures of metals is one of the current aims of the Fracture Research Laboratory in the University of Illinois Department of Theoretical and Applied Mechanics.

Research on how to construct a reliable motor case for solid-propellant missiles is directed by Professor H. T. Corten. The solid fuel in a missile such as the Polaris is carried and burned in a container called the motor case. The case itself is dead weight as far as missile performance goes, but it must be strong enough to withstand the high pressures involved in liftoff. The problem is how to make a motor case which is both light in weight and structurally reliable.



The large rupture in this rocket motor case resulted from a flaw which was impossible to detect before testing. One of the four exhaust ports has been blown away entirely by the test pressure.

Motor cases are fabricated by welding sheets of high strength steel together; failure occurs by catastrophic fracture which begins with tiny flaws, frequently at the welds. Until recently the motor cases were tested for reliability by stressing them twice to the pressure anticipated during the firing of the missile. University researchers found that this testing procedure actually damaged the motor cases by increasing some of the flaws to near critical size, making the motor case unable to withstand the pressures of actual firing.

To remedy this, the engineers devised an improved procedure: a single test in which a pressure approximately 10 per cent higher than the firing pressure was imposed. This test singles out the motor cases with flaws of critical or near-critical size, but does not damage the remaining cases so they will rupture on the firing cycle.

In addition to motor cases, other rocket and aircraft structural components offer metal fracture problems, especially when they are made of the so-called refractory metals such as tungsten, columbium, chromium, and molybdenum. The mechanical behavior of these materials under extreme rates of loading and temperature is being studied by a group under Professor G. M. Sinclair. One advantage of refractory metals is that they retain their strength at high temperatures. An experimental aircraft, the X-15, recently flew 3,900 miles an hour; at that speed, the temperature of the leading edges of the wings was about 1,500° F. The ability to withstand such extreme conditions will give refractory metals widespread use in the future.

But these materials, like most other things in this world, have their drawbacks: for example, many of them

become "brittle" and fracture easily at low temperatures. A plane with parts of tungsten or molybdenum could withstand the high temperatures of flight but the metal might fracture at the ordinary temperatures of takeoff. The "low" temperature at which these metals become brittle varies with the metal and is influenced by factors such as stress, temperature, and impurity content.

Results of the work to date suggest that a reasonably accurate mathematical description of the flow and fracture characteristics of such metals can be worked out. An equation describing the behavior of columbium in terms of the variables has already been developed. Such mathematical descriptions will make possible the prediction of the behavior of metals at low temperatures and will indicate methods of fabricating materials which will withstand the extremes of temperature and stress.

Fracture research has fundamental as well as practical significance. It contributes to the general knowledge of the behavior of metals, bringing forth results that are applicable to the use of metals in buildings, bridges, industrial machines, and consumer goods. Today, the "back to the old drawing board" philosophy of the past is fast disappearing; making progress by making mistakes is giving way to the scientific prediction and prevention of the calamities that result from metal fracture.

PHOTOGRAMMETRY SHORT COURSE

A short course on Photogrammetry and Photo-Interpretation will be conducted at the University of Illinois January 30 through February 2, 1962. Civil Engineering Professors H. M. Karara and T. H. Thornburn will be in charge, respectively, of the two portions

of the course. The course, administered by the Civil Engineering Department in cooperation with the Division of University Extension, will be so conducted that beginners as well as professionals can benefit from it. For full details please contact: Supervisor of Engineering Extension, Room 116d Illini Hall, University of Illinois, Urbana, Illinois.

FOURTH SANITARY ENGINEERING CONFERENCE

Water distribution systems will be the subject of the Fourth Sanitary Engineering Conference to be held on the University of Illinois campus in Urbana on February 13 and 14, 1962. The conference is sponsored jointly by the Division of Sanitary Engineering of the Illinois Department of Public Health and the University of Illinois Department of Civil Engineering. This conference is designed to be of value to operating and administrative personnel, contractors, and consulting engineers concerned with water supply. Further information may be obtained from Ben B. Ewing, Professor of Sanitary Engineering, University of Illinois, Urbana, or from C. W. Klassen, Chief Sanitary Engineer, Department of Public Health, Springfield, Illinois.

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